INSTRUCTION MANUAL

DIFFERENTIAL ADMITTANCE ADAPTER

MODEL 100-PA-1008

DRANETZ
ENGINEERING
LABORATORIES
INCORPORATED

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SECTION I

OPERATION

1-1 FUNCTIONS OF CONTROLS AND TERMINALS

Table I lists the functions of controls and indicators of Differential Admittance Adapter Model 100-PA-1008.

Table I. FUNCTION OF CONTROLS AND TERMINALS

Control or Terminal	Function
RANGE switch in MICROMHOS 12 Positions: 100, 250, 500, 1K, 2.5K, 5K, 10K, 25K, 50K, 100K, 250K, 500K.	Presets full-scale ranges for admittance. Admittance is indicated in parallel conductance and susceptance.
MODE 3-position switch Y - FS - 0	Selects precalibration and operation modes: Y - Admittance FS and 0 - Adjustment for calibration of zero and full scale positions only. Precalibration holds for any amplitude range or admittance.
Y+ terminals	Five-way terminals for connection to device being measured. Low side of terminals are grounded.
Y- terminals	Five-way terminals for connection to device being measured used in conjunction with Y+ input to measure the difference between two admittances. Low side of terminals are grounded.
DIFF - Y+ switch	In the Y+ position, selects a direct measurement of a two-terminal admittance. In the DIFF position, measures the difference between two admittances.
EXT. AMP. connector	* EXT. AMP. connector is provided on the plug-in adapter for measuring higher ranges of admittance & Freq. above 20 kHz.
SIG MONITOR terminal	Provides a monitor point to observe the 30-millivolt signal (a function of the admittance Y).

* Best results are obtained with external amplifier thru cable supplied for direct connection to 100-PA-1008 thru phone jack on front panel.

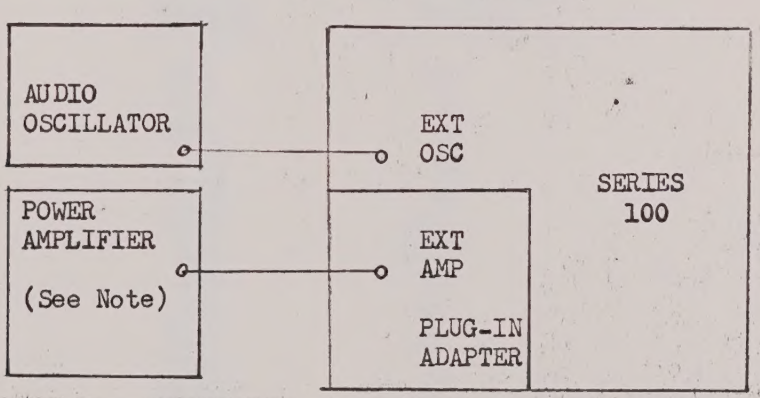
1-2 OPERATING PROCEDURE

a. Remove existing plug-in adapter from the Series 100 Complex Impedance-Admittance Meter and replace with Differential Admittance Adapter Model 100-PA-1008.

NOTE

If plug-in adapter is not installed properly, the LIMIT INDICATOR on the Series 100 will be on when the equipment is energized. Tighten thumb screws on plug-in adapter until LIMIT INDICATOR lamp is off.

b. Connect the equipment as shown in figure 1-1.



NOTE: External Power Amplifier is used for admittance ranges not capable of being driven by the internal emitter follower.

Figure 1-1. Equipment Setup

c. Follow instructions for measuring admittance in Section II of Model 100B or Model 100C Instruction Manual.

NOTE

When performing direct measurement of a two-terminal admittance or a measurement of the difference between two admittances, observe the notes and precautions listed in paragraph 1-3.

1-3 NOTES AND PRECAUTIONS ON THE USE OF THE MODEL 100-PA-1008 ADAPTER

a. The internal Power Emitter Follower drives admittance ranges up to 2.5K umhos when used with the Model 100B only. When used with Model 100C or 100B Mod 4, the internal emitter follower permits admittance ranges up to 25K umhos.

b. An external Power Amplifier is only required for those ranges above those not driven by the internal Power Emitter Follower.

c. NOTE: The external Power Amplifier is required to provide the unit with a 3 volt rms undistorted sine wave. The Power Amplifier is connected to the PWR AMP input of the plug-in adapter. When the external Power Amplifier is not rquired, The External Audio Oscillator is connected to OSC input in Model 100B or 100C.

d. The following load impedances correspond with each admittance range:

Range (umhos)	Load Impedance (ohms)
100	10K
250	4K
500	2K
1K	1K
2.5K	.4K
5.0K	200
10K	100
25K	40
50K	20
100K	10
250K	4
500K	2

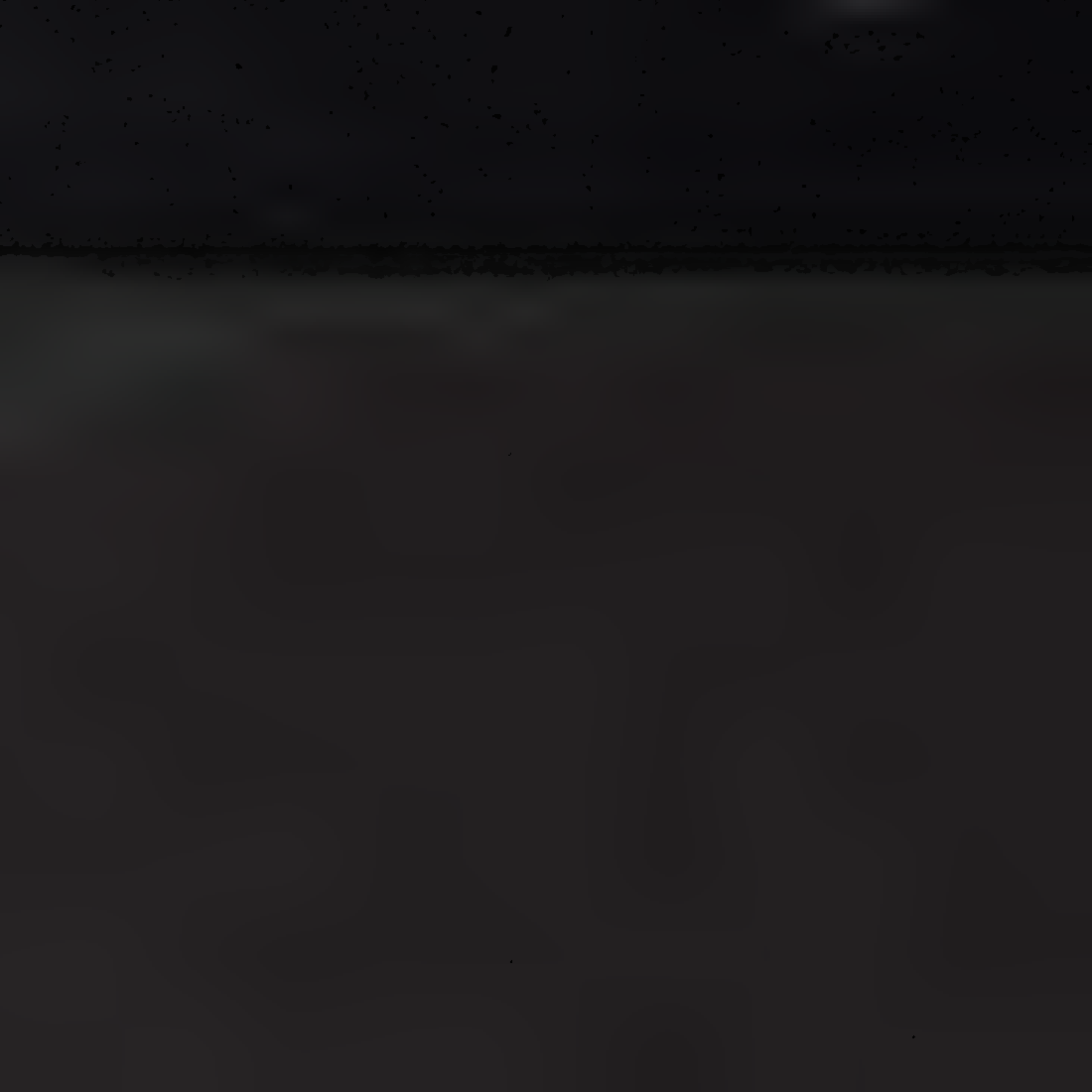
Note that if the range is 500K umhos, the load impedance is 2 ohms and requires a Power Amplifier which can provide the required 3 volts rms undistorted sine wave signal. In the same case, if two inputs are used (for difference measurements), the load impedance is 1 ohm. For a 250K range, the load impedance is 4 ohms and the same principles apply, and so forth.

e. An EXT. AMP. input is provided on the adapter for connecting a Power Amplifier. This EXT. AMP. input connector is in addition to the one used on the Series 100 units. The EXT. AMP. connector on the plug-in adapter should always be used for the ranges not covered by the internal Emitter Followers.

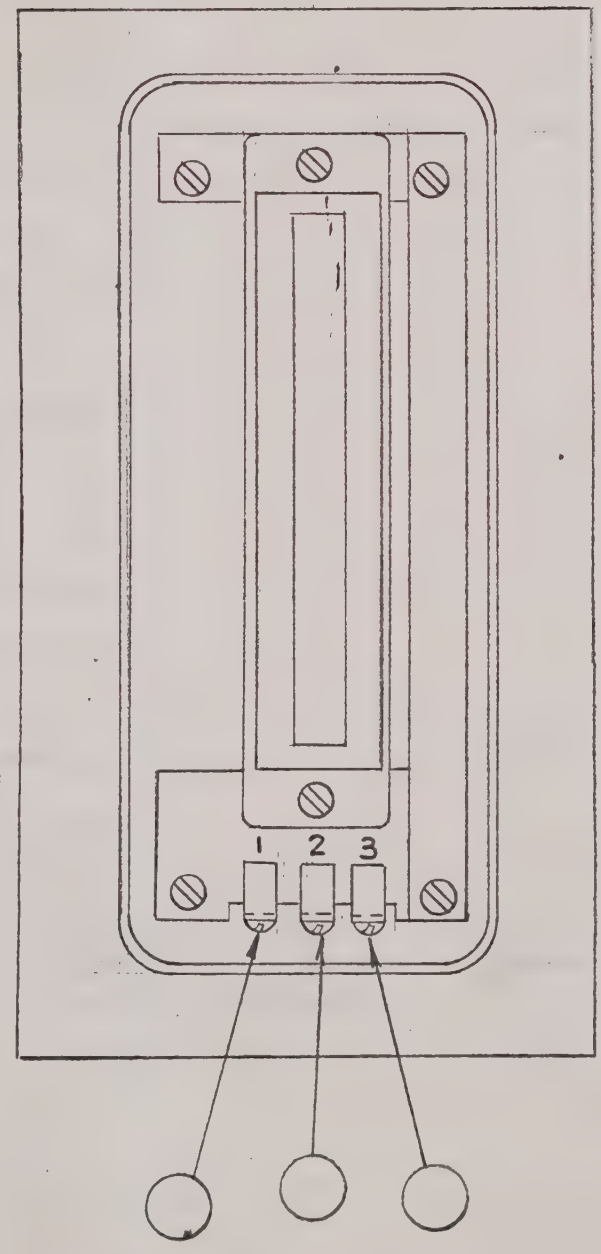
CAUTION

The External Power Amplifier should be fused or current limited to a 5 ampere maximum.

f. When performing a measurement of the difference between two admittances, the inputs are applied to Y+ and Y- respectively. The input applied to Y- is used to subtract G and B from Y+ to provide a corrected indication on the Model 100B or 100C. Note that G is always positive, whereas B can be positive or negative.



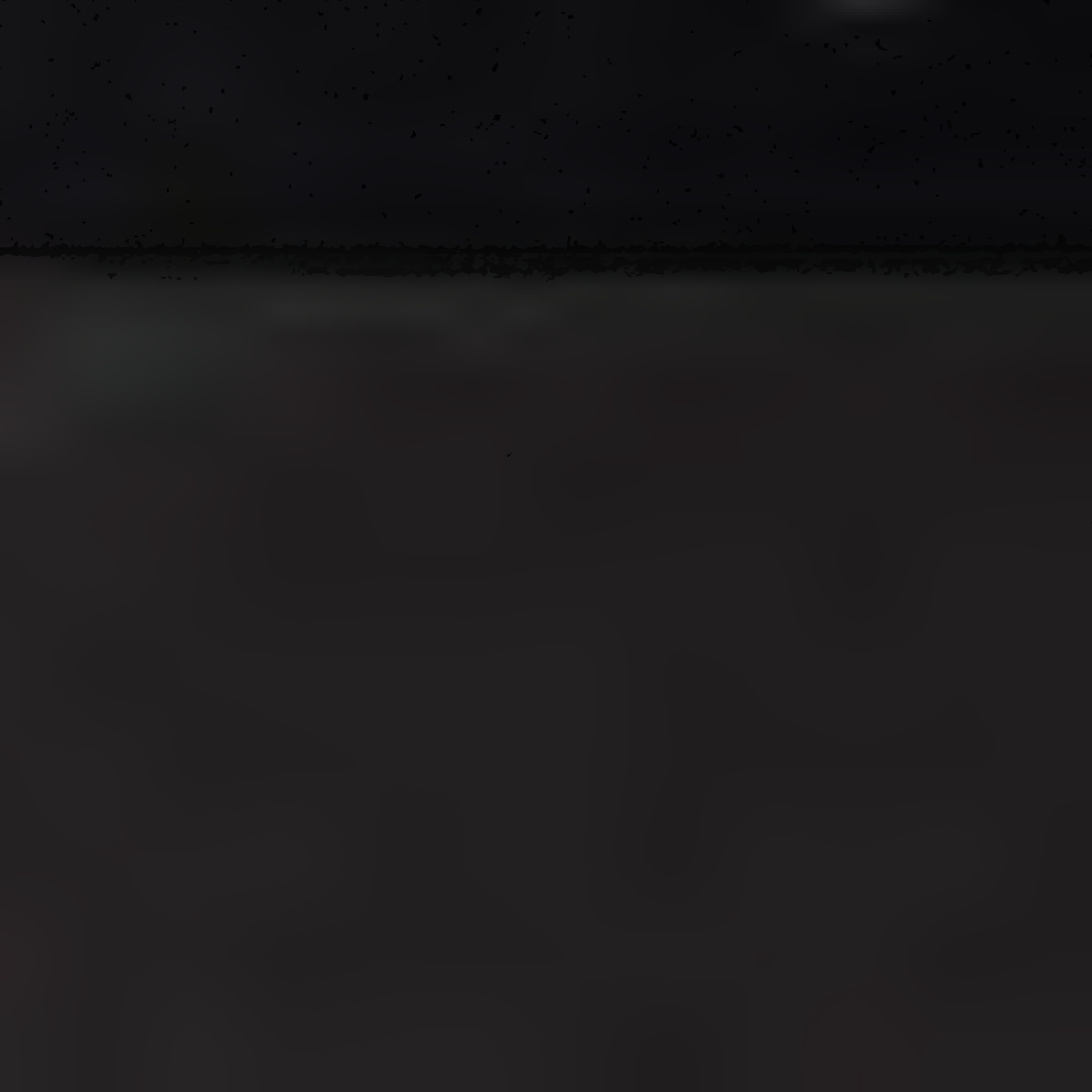
1-CASE GROUND
2-PWR. LINE GROUND
3- CIRCUIT GROUND



MODEL 100 PA 1008

GROUND LUG LOCATION

FIGURE 1-2



SECTION II

PRINCIPLES OF OPERATION

2-1 GENERAL DESCRIPTION

a. Figure 2-1 is a block diagram and figure 2-2 is a schematic diagram (Drawing No. 100,195) of the Differential Admittance Adapter Model 100-PA-1008.

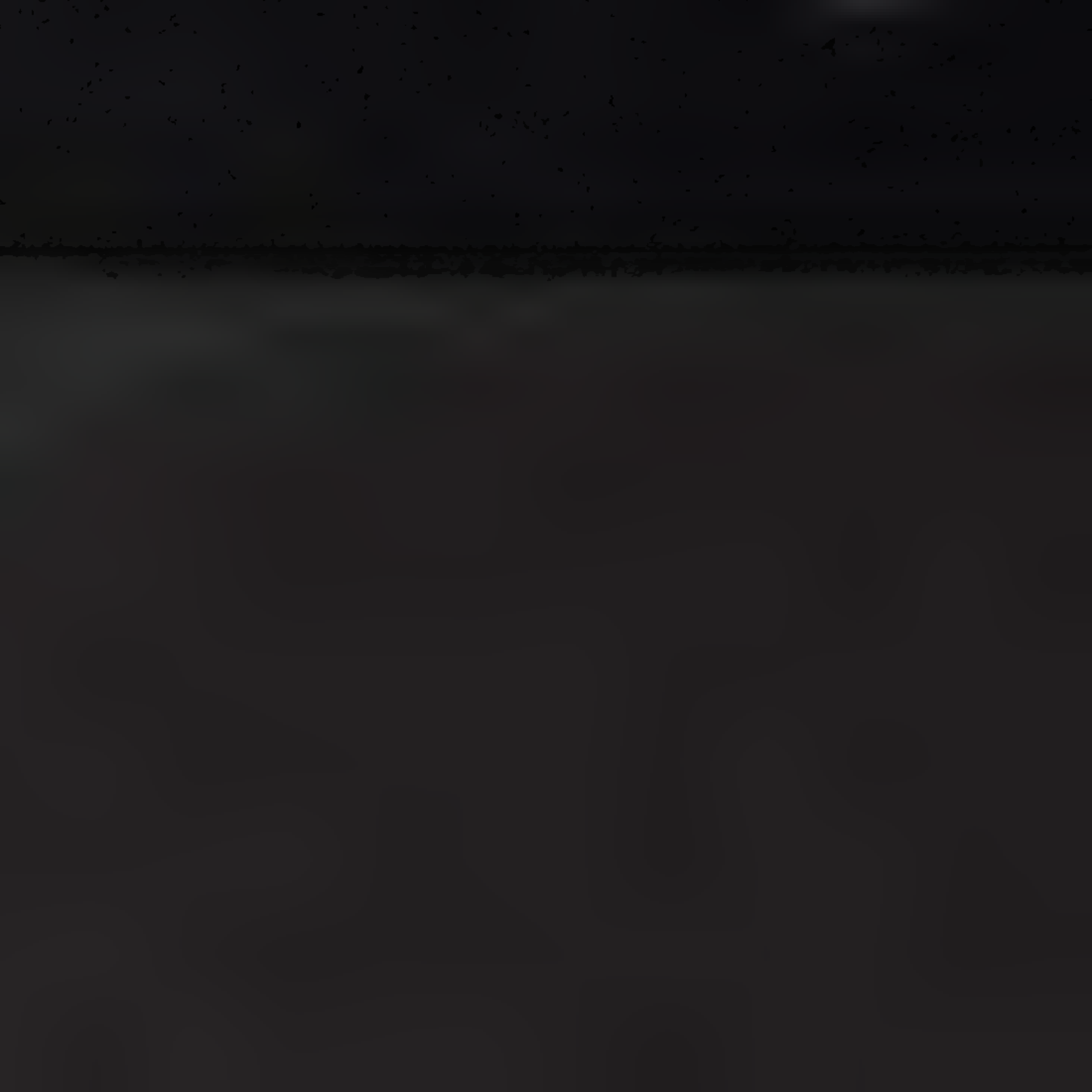
b. A 3-volt reference signal is applied to a Differential Current Transformer which produces a voltage proportional to and in phase with the current, and is proportional to the amplitude of the unknown admittance.

c. In the Differential Mode, the voltage is proportional to the difference in current and is proportional to the vector difference in phase, and subsequently is proportional to the amplitude of the differences of admittances.

d. The voltage representing the current (equal to 30 mv full scale for each admittance range) is scaled to produce a voltage which is applied to the Z-Y amplifier of the Series 100.

e. The 3-volt reference signal is also applied to the Series 100 to produce in-phase and 90° phase square waves as described in the Model 100B or Model 100C Instruction Manuals.

f. The sine-wave signal voltage representing current, the in-phase square wave and the 90° in-phase square wave are the necessary inputs for the 100 Series units to produce a measurement of $Y = G \pm jB$.



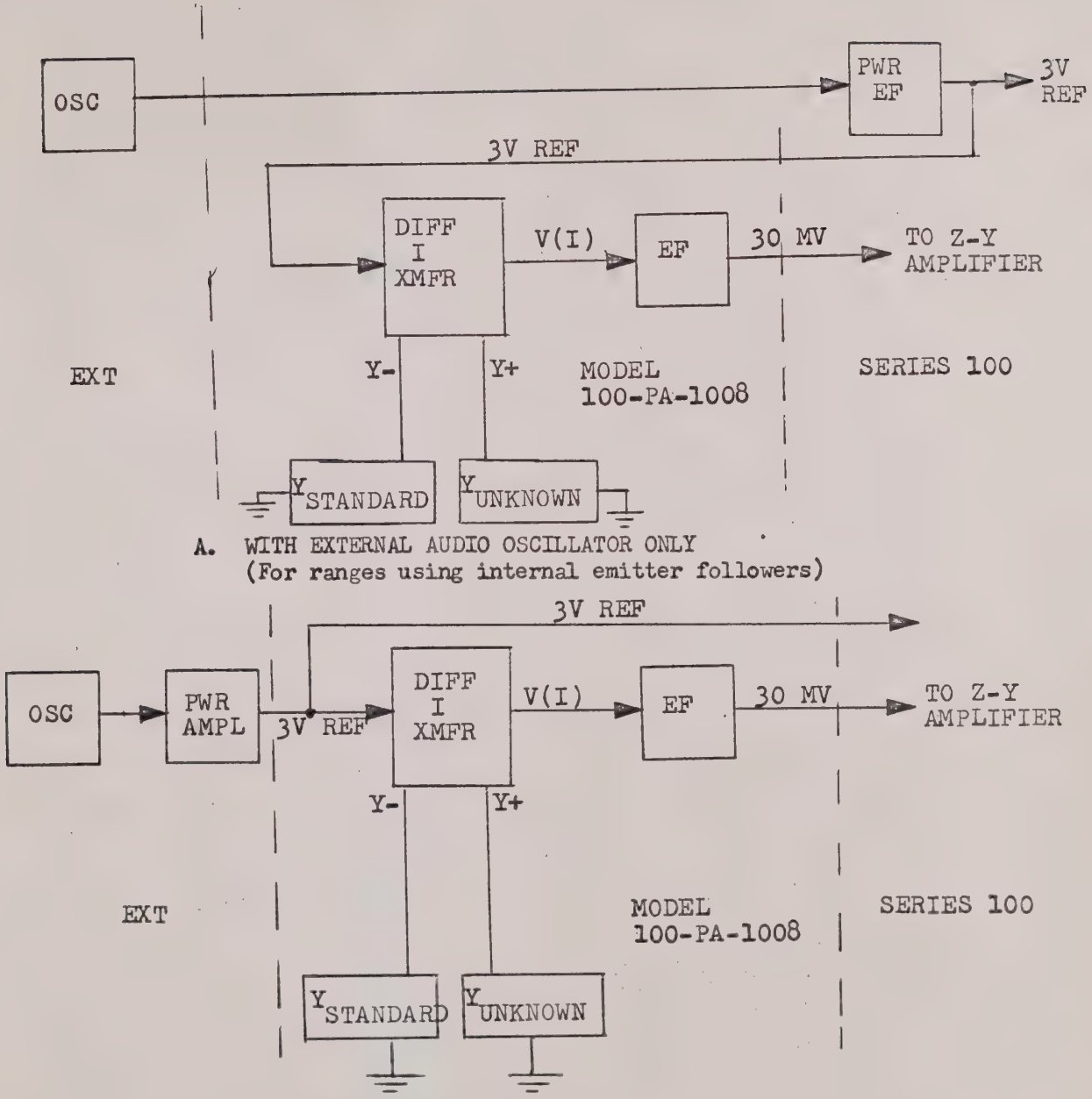
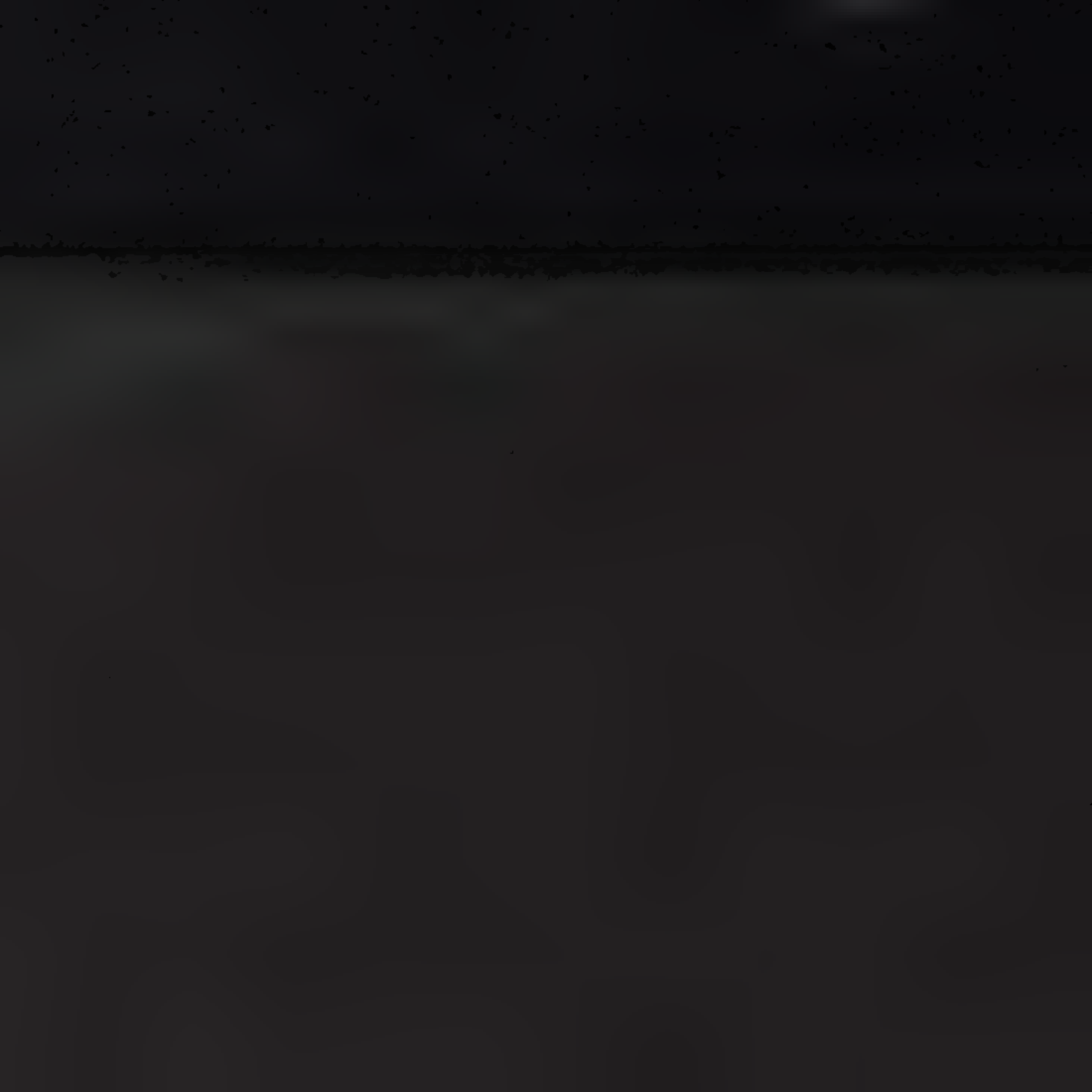


Figure 2-1. Block Diagram of the Differential Admittance Adapter



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WARRANTY

All Products of Dranetz Engineering Laboratories, Inc., are warranted against defective material and workmanship for a period of one year from the date of delivery. Dranetz Engineering Laboratories, Inc. will repair or replace all defective equipment returned to it during the warranty period, without charge provided there is no evidence that the equipment has been mishandled or abused.

Before returning any equipment under warranty: Check with factory representative for special instructions.

RETURNED MATERIAL AUTHORIZATION

NOTE: This completed form must accompany shipment. Date _____

Date of original purchase: month _____ year _____ Original P.O. No. _____

Customer ship Prepaid to:

Dranetz Engineering Laboratories, Inc.
2385 South Clinton Avenue
South Plainfield, N.J. 07080

Return to:

_____
_____
_____

Ship via _____

Description of returned instrument:

Model No. _____ Serial No. _____

Model No. _____ Serial No. _____

Reason for return (specify malfunction in detail)

_____
_____
_____
_____
_____
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_____
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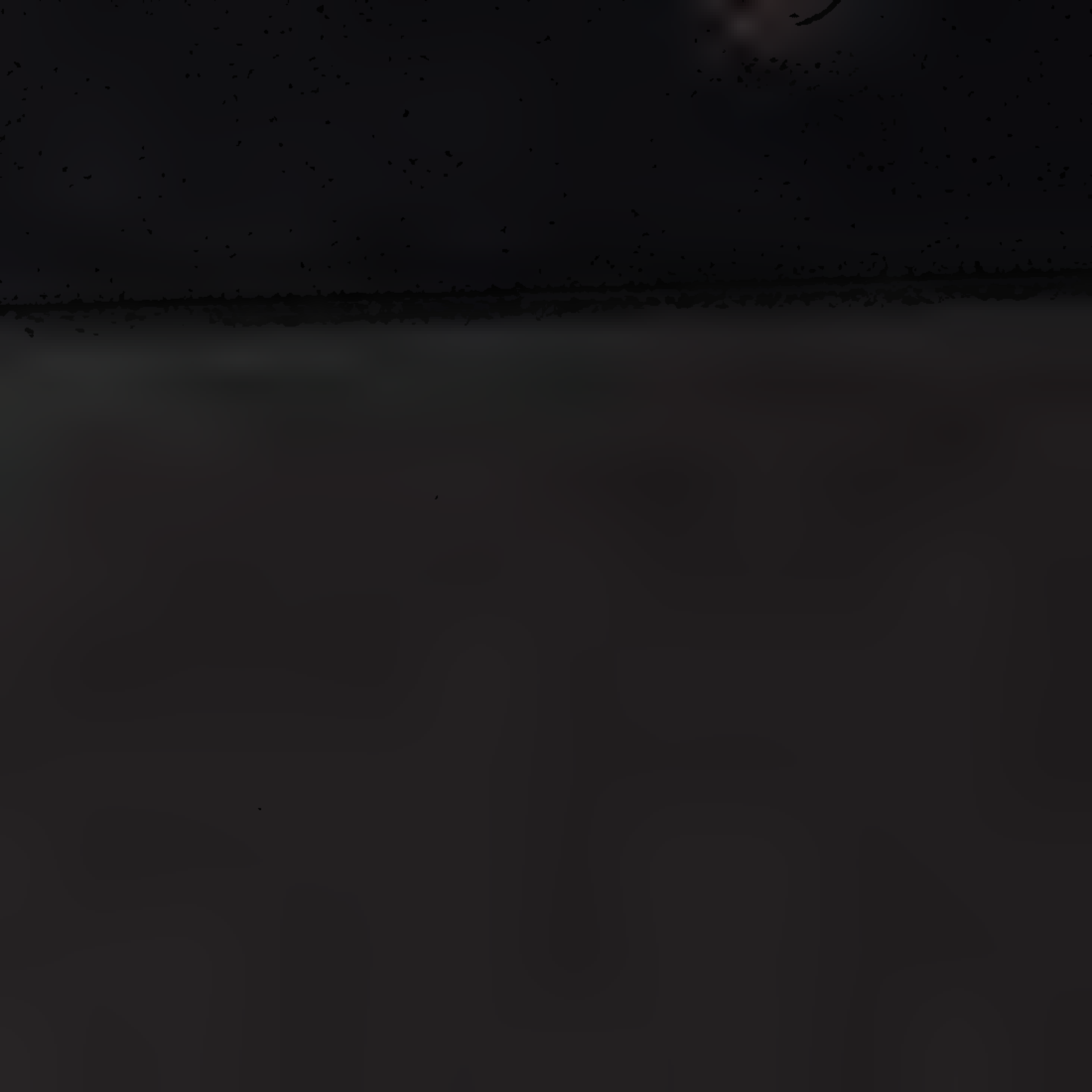
_____
_____

Telephone No. _____ Signature _____

Complete and exact malfunction information will expedite return of unit



CATALOG G

DRANETZ

PRECISION INSTRUMENTATION for

PHASE/GAIN

IMPEDANCE

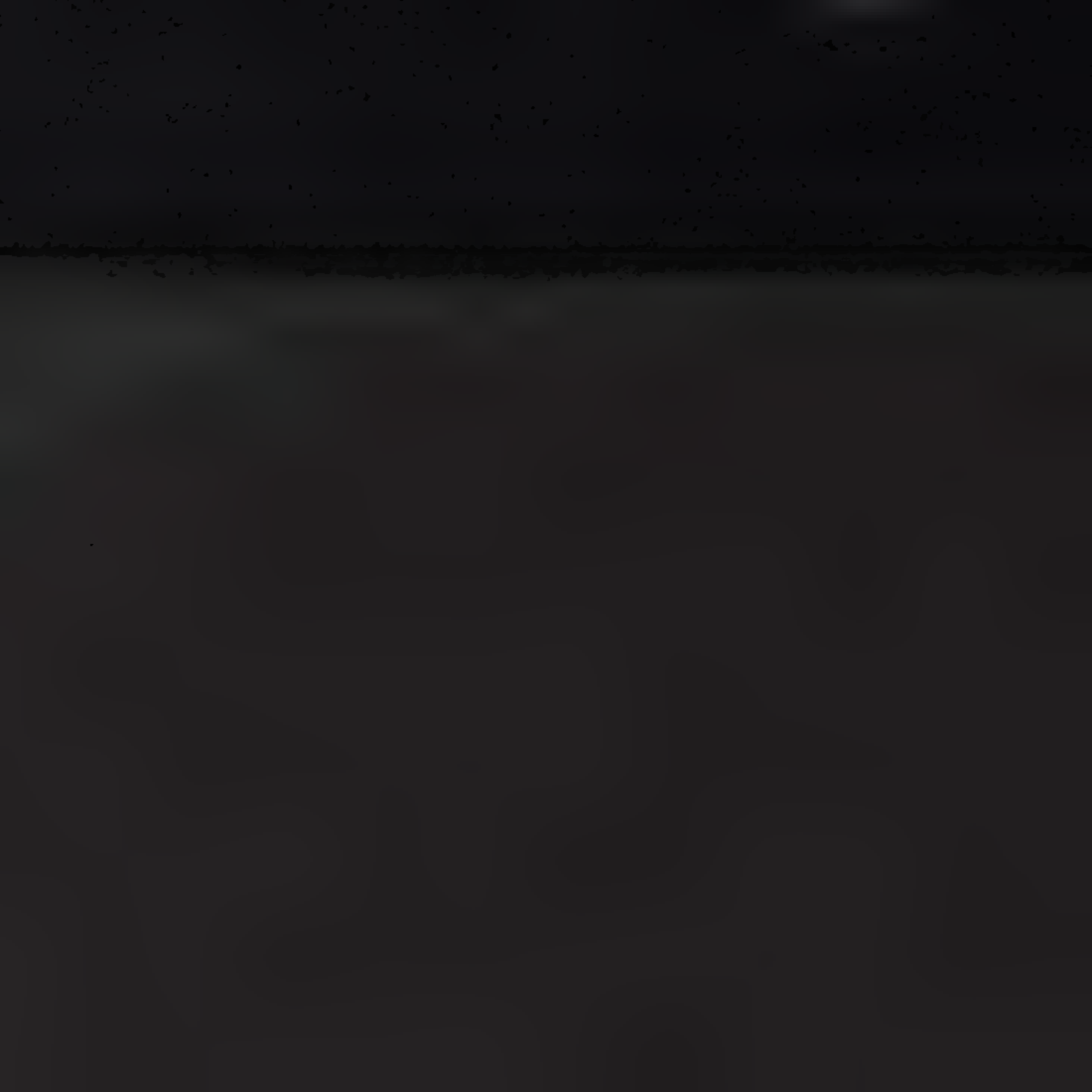
CURRENT

VOLTAGE

QUALITY FACTOR Q

TIME/FREQUENCY

POWER LINE DISTURBANCE



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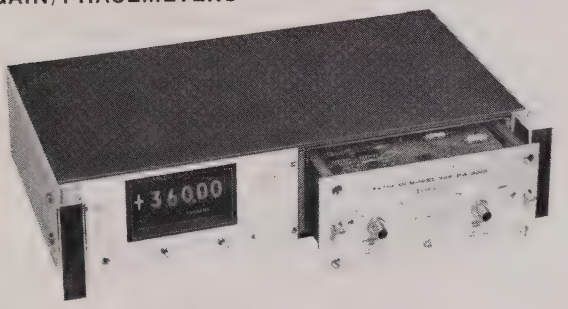
SERIES 305
SUPER PERFORMANCE PHASEMETERS AND GAIN/PHASEMETERS*



305 Series Phasemeters provide the highest available accuracy, along with many operational features. Designed for the calibration laboratory, the design engineer's bench, the production line and automatic test systems, the 305 is the most widely accepted phasemeter in industrial, and governmental organizations. **

FEATURES
- No hands 86 dB dynamic range
- Automatic or programmable operation and calibration
- Highest accuracy — to 0.03°
- Repeatability better than 0.01°
- Rejects harmonics and noise
- Wide frequency range — 1 Hz to 11 MHz

FLEXIBILITY THROUGH PLUG-IN CONCEPT
The plug-in concept of the 305 offers a wide selection of characteristics. Three standard mainframes and nine plug-ins are complemented by a variety of options, such as programmability, high speed and auto-calibration. Special modifications are also available. In addition, modular construction throughout provides maintainability at both component and P.C. card levels for ease and speed of servicing.

WIDE FREQUENCY RANGE
The basic mainframe provides a direct frequency coverage of 2 Hz to 700 kHz with high accuracy. By the use of frequency converting plug-ins such as the 305-PA-3005, standard units can handle frequencies up to 11 MHz. Special units can be provided for higher frequency.

NO HANDS OPERATION
The Series 305 Phasemeters require no controls or adjustments by the operator. These units are also equipped with several significant automatic features. These include automatic selection of angle range, automatic sensing of leading or lagging angle, automatic selection of the output time constants, and automatic setting of AC gains.

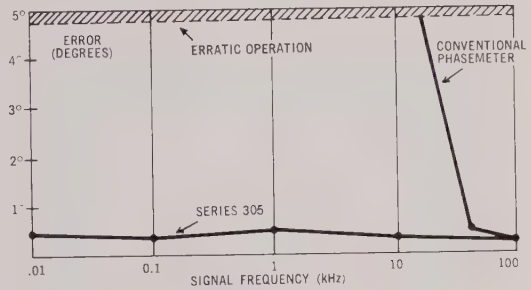
HIGHEST ACCURACY
Accuracy to better than ±0.03° is attained with precision mainframes and carefully designed plug-ins. Mainframes exhibit precise zero crossing detection, angle-to-DC conversion linearity to approximately ±0.01° and outstanding DC stability. Plug-ins are designed for accurate conversion of sine wave (also square wave) inputs to square waves through carefully controlled amplifier circuitry, use of gain autoranging, and harmonic filters where necessary.

INSENSITIVITY TO INPUT LEVEL
Series 305 plug-ins are available with a guaranteed accuracy of better than ±0.05° even with independent input level variations of 60 dB. Typical accuracy can approach ±0.03° as shown on the following page.

NON-AMBIGUOUS ANGLE READINGS
Two phase angle ranges in the 305 eliminate the ambiguity or "dead zone" error inherent in all other phasemeters (usually at 0°/360° or −180°/+180°). An automatic system switches to the 0°/360° range for angles near 180° and to the −180°/+180° range for angles near 0°. Unique guard bands prevent dead zones near switching points.

REPEATABILITY, STABILITY, AUTOCALIBRATE
Repeatability of the 305 is better than ±0.005°; temperature coefficient is ±0.001°/°C; and DC output drift is better than ±0.05° over any 30 day period. The autocalibrate feature eliminates virtually all DC errors in digital panel readout and BCD rear panel outputs.

NOISE IMMUNITY
Unique patented circuitry minimizes noise errors and makes possible accurate phase measurements under noise levels where other phasemeters become completely useless. The accompanying curve compares the phase error of the model 305 with that of a conventional phasemeter with broad band noise in both channels.



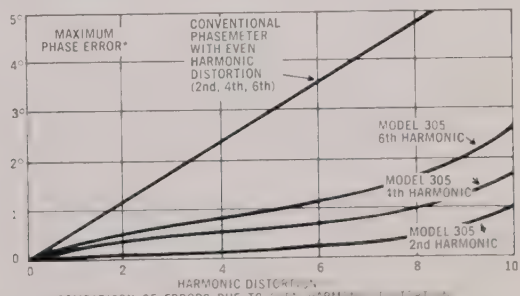
PHASE READING ERROR VS SIGNAL FREQ. FOR GAUSSIAN NOISE (FLAT TO 5 MHz) IN BOTH CHANNELS FOR S/N = 10

PROGRAMMABLE OPERATION
Standard mainframes are provided with rear connections for over-riding the automatic time constant and angle range selectors by relay contact closures. Options are provided for control by DTL and TTL logic.

DIGITAL READOUT
In addition to analog DC output, standard mainframes are available with up to 5 digit panel readouts (i.e., 0.00° to ±180.00° and 0.00° to +360.00°) and BCD outputs for each digit. Autocalibrate feature eliminates virtually all meter drift and scaling errors.

RAPID PHASE NULLING
For production testing of filters and other networks, an additional analog deviation-panel meter (305D) provides an easy means of adjusting a test angle to any accurate value. Presetting can be done in seconds without any other equipment. The precision digital panel meter monitors actual test angle continuously.

ABILITY TO REDUCE HARMONICS
The 305 is designed to reduce significantly the errors due to even harmonic distortion without the use of filters. The accompanying curve compares the error due to even harmonic distortion (maximized for worst case harmonic angle) on conventional phasemeters and on the model 305. (Odd harmonics in-phase with fundamental contribute no error.)



COMPARISON OF ERRORS DUE TO EVEN HARMONIC DISTORTION
* For worst case phase relationship between harmonic and fundamental

*Manufactured under U.S. Pat. No. 3,725,781
**For extensive application information, write for availability of "Applications Handbook of Precision Phase Measurement."

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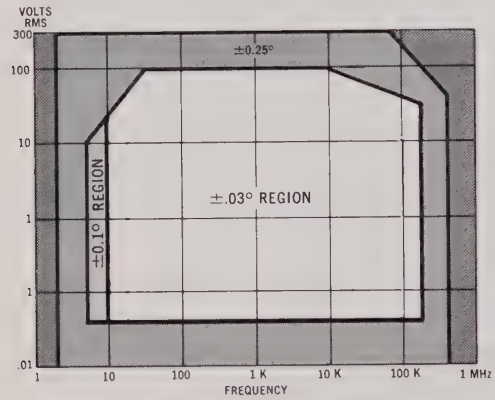
SERIES 305

HIGH PERFORMANCE PLUG-INS

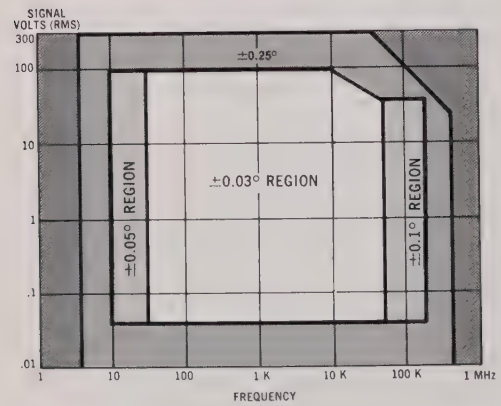
The variety of plug-ins available provides unlimited flexibility for the Series 305 Phasemeters in meeting many phase measurement problems. In addition to an expanding line of standard plug-ins, custom units can be designed for special needs.

305-PA-3001 AUTORANGING PLUG-IN

This plug-in features high accuracy over a broad range of input levels and frequencies. Autoranging of gain in each channel assures high accuracy (±0.05° guaranteed) over a dynamic range of 60 dB (50 mV to 50 V rms) for independent levels of inputs, with a useful range of 90 dB (10 mV to 300 V rms). This plug-in covers the range from 2 Hz to 700 kHz, with its highest accuracy in the 50 Hz to 50 kHz range. The curves shown illustrate typical accuracies as a function of level and frequency. The 305-PA-3001 also features compatibility with Textronix probes and includes front panel lamps to indicate when either input signal is below 50 mV or above 50 V rms.



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001 FOR EQUAL SIGNAL INPUTS



TYPICAL ERROR CONTOURS FOR 305 w/305-PA-3001 FOR UNEQUAL INPUTS — REF. 0.3 VOLTS RMS

While the above accuracies apply to sine wave inputs, this instrument can also be used for square wave and amplitude modulated signals.

305-PA-3002 SINGLE RANGE PLUG-IN

The 305-PA-3002 is similar to the model 305-PA-3001 except that it does not include autoranging or limit indicator lamps. For sine wave inputs the standard unit is designed for guaranteed ±0.05° accuracy (typically ±0.03°) over independent signal levels of 50 mV to 500 mV rms, with a slight reduction in accuracy from 10 mV to 3 V rms. Other level ranges can be supplied on special order; Tektronix probes can be used for high input levels. This plug-in is useful for sine wave, square wave and amplitude modulated signals.

305-PA-3005 HIGH FREQUENCY PLUG-IN

This high frequency plug-in is designed for high accuracy to 11 MHz. Using a self tracking oscillator, the input signals are converted to 40 kHz for precision measurement by the mainframe. Input attenuators (50 ohms) are provided with 10 dB steps, to cover a range of 1 mV to 3 V rms in either channel. Front panel lamps indicate when input levels are out of range or when level controls are improperly set. The self tracking oscillator can be controlled by channel A signal or by a third independent signal.

305-PA-3007 PROGRAMMABLE AND AUTORANGING PLUG-IN

This programmable plug-in features all of the characteristics of the model 305-PA-3001. In addition it includes increased input gain to achieve operation down to 1 mV rms. The unit can be operated either in an automatic or programmable mode. Without rear connections, the plug-in operates automatically as a 305-PA-3001; however, by utilizing rear connectors, the internal autoranging can be over-ridden and additional internal gain can also be inserted. Programming is available by DTL and TTL logic.

305-PA-3008 SINGLE FREQUENCY PLUG-IN

The 305-PA-3008 is a special purpose plug-in designed for precision calibration of 50 Hz, 60 Hz and 400 Hz power line equipment such as wattmeters, phase detectors and watt hour meters. This instrument can measure phase difference between two voltages, two currents or between a voltage and a current. The unit covers a voltage range of 25 V to 250 V rms and a current range of 0.1 to 5 A rms. The basic plug-in covers the frequency range of 50 Hz to 500 Hz. Plug-in filters, available for 50 Hz, 60 Hz and 400 Hz, assure reduction of second harmonic by at least 40 dB and higher harmonics by at least 50 dB. A front panel zero control provides adjustment for high accuracy (±0.1°) at any single frequency.

305-PA-3009 WIDE BAND NETWORK ANALYZER PLUG-IN (GAIN/PHASE/AMPLITUDE)

This plug-in measures the voltage amplitude of each signal input (in volts or dBV, selectable by operator), the phase difference between inputs, and the amplitude ratio of inputs. Featuring auto-ranging of gain in both channels, it requires no manual setting of gains for any measurement. Simultaneous DC outputs on mainframe are proportional to all four fuctions. A front panel switch selects the measuring mode for digital panel readout — channel A voltage, channel B voltage, phase difference, or amplitude ratio. Lamps on the front panel of the plug-in indicate the proper decade multiplier. The 305-PA-3009A is designed for extending the low frequency range.

305-PA-3010 SPECIAL PURPOSE PLUG-IN

This plug-in is typical of special purpose plug-ins which can be supplied to meet unique problems. Having high input impedance, it is equipped with closely matched low pass filters to pass 125 Hz signals while rejecting 400 Hz signals, solving problems in many types of servo control systems. Similar units can be readily designed for other special voltage and frequency applications.

305-PA-3015 PROGRAMMABLE PLUG-IN

Intended for use in automatic test systems, this plug-in has two selectable filters for harmonic rejection and selectable gains to handle inputs from 50 mV to 50 V rms. Filter (or filter out) selection as well as gain switching is accomplished by contact closures across terminals on the rear of the main frame.

PRECISION TRANSFORMER ISOLATION NETWORKS

Dranetz TR 3100 series networks are available for input voltage isolation with minimum phase error and flat gain response. For use with balanced or signal ended sources, these units are equipped with internal preamplifiers to produce outputs in the 30 mV to 3 V rms range (for use with 305 Series Phasemeters) for input levels from 50 mV to 500 V rms. These transformer units are packaged for direct plug-in into the input BNC's of the phasemeter, and draw B+ power from the front panel accessory connector of the phasemeter plug-in. Size: 2¾" x 2¾" x 2". Input: banana jack. Output: BNC.

Model TR—	Zin	Com. Mode Rej: >60 dB for frequency	Range for ±0.1° typical shift	Range for ±0.3° typical shift	Gain ±2%
3101	1 megΩ 70 pF	Below 1 kHz	20-400 V rms 50 Hz-20 kHz	5-400 V rms 10 Hz-25 kHz	x 0.01
3102	100 kΩ 70 pF	Below 10 kHz	2-40 V rms 50 Hz-20 kHz	0.5-40 V rms 10 Hz-25 kHz	x 0.1
3103	10 kΩ 70 pF	Below 25 kHz	0.2-4 V rms 50 Hz-20 kHz	0.05-4 V rms 10 Hz-25 kHz	x 1.0

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SERIES 305

HIGH PERFORMANCE PHASEMETERS

MAINFRAME SPECIFICATIONS

Frequency Range: 2 Hz to 11 MHz (see plug-in data)

Angle Ranges: 0.00° to ±180.00° or 0.00° to +360.00° manually or automatically selected. End-of-range measurement errors are prevented by 15° automatic guard zones.

Analog Output
Range: −1.8000 to +3.6000 Vdc corresponding to measured angle; 10.0 mVdc per degree
Accuracy: See plug-in specifications
Output Impedance: 100 ohms

DC Resolution: Infinite
Linearity: Approx. ±0.01°
Repeatability: Better than ±0.005°
Time Constants: Automatically selected; 10 ms for frequency >5 kHz, 50 ms >500 Hz, 350 ms >50 Hz, 700 ms >2 Hz (Note: 4.6 time constants to respond to better than 99% of step change).
Warm-up Drift: Approx. 0.05° after first minute.
Long Term Drift: Typically less than ±0.05° per month
Temp. Coefficient: Approx. ±0.001°/°C
Recommended Output Devices: Recorders, DVM's, A-D Converters, Printers
Self Check: Front panel switches; dc outputs correspond to −180.00°, 0.00°, +180.00° and +360.00°
Error Rejection: False triggers due to high frequency noise are locked out for signal to noise ratios better than 10:1. Errors and fluctuations due to waveform dissymmetry or low frequency noise reduced by at least 10 to 1.
Harmonic Rejection: Worst case errors due to even harmonic distortion reduced by approximately 5:1 without filters. Odd harmonics in-phase with fundamental contribute no error.
Operator Adjustments: None.

Operating Temp. Range: 0° to +50°C
Grounding: Independent grounds for signal, chassis, and power line. (For safety, chassis and power line grounds connected at factory.)
Remote Programmability (standard on all mainframes): By rear connector pins. Over-ride by contact closure of automatic time constant selection and angle range. Factory installed wiring from rear connector to plug-in for use with programmable plug-ins.
Modular Construction: Circuits on removable plug-in cards, extenders supplied for ease in servicing.
Size: 3½″ high, 16″ deep, 19″ rack/portable package.
Weight: 20 lbs; shipping 30 lbs.
Power: 115/230 V, 50-400 Hz, <0.75 A (specify voltage and frequency when ordering).
Plug-In Accommodation: Accepts 305-PA-( ) plug-ins. Mainframes and plug-ins are interchangeable.

ANGLE PRESENTATION

	Model 305	Model 305B	Model 305C	Model 305D
DIGITAL				
Display	None	4 digit plus sign	5 digit plus sign	
Angle Ranges	Not Applicable	0.0° to ±180.0° and 0.0° to +360.0°	0.00° to ±180.00° and 0.00° to +360.00°	
Resolution	NA	0.1°	0.01°	
BCD Output	None	BCD coded (1248), 4 lines per digit plus polarity line; TTL/DTL compatible (<0.8 V to > +2.4 V dc). Read and hold on command, and data ready features available on rear connector.		
Warm-up Time	NA	30 minutes (1 minute with option 107)		
Zero & FS Controls	NA	Front panel for FS & 0 (no adjustments with option 107)		
ANALOG				
DC Output	10.0 mV/°; 0.0000 V to 3.6000 V and −1.8000 V to +1.8000 V corresponding to 0.00° to 360.00° and −180.00° to +180.00°; infinite resolution.			
DC Offset	None			Continuously adjustable angle offset. Analog panel meter and DC output indicate deviation from offset.

OPTIONS

#101 Rear connectors for signal and reference inputs, BNC[4]

#102 Full mainframe programmability; includes self check, angle range and time constant selection, DTL and TTL compatible.

#103 High speed analog output response. Time to respond to within 99% of step change: 1 ms for frequency >5 kHz, 10 ms >500 Hz, 100 ms >50 Hz, 1 second >5 Hz. (Temp. stability ±0.01°/°C)
(Opt. 103 not available with Opt. 107 below)

#107 Automatic calibration checks and automatically readjusts digital readout and BCD output circuits and at 0° and 360° to reduce readout errors to ±0.01°. This option available only on 305C.

COMBINED PLUG-IN AND MAINFRAME SPECIFICATIONS

MODEL	FREQUENCY RANGE	INPUT LEVELS (Independent)	INPUT Z	ACCURACY[2] WITH INDEPENDENT LEVELS UNLESS OTHERWISE INDICATED Analog output accuracy: As specified below. Digital phase accuracy: For model 305C, same as analog accuracy. For model 305B, add ±0.15° digital readout error to analog accuracy specified.
305-PA-3001 Auto Ranging Plug-in	2 Hz to 700 kHz	10 mV to 300 V rms up to 10 kHz and to 50 V rms up to 700 kHz; can be extended to 40 kV rms with Textronix probes. Each channel has automatic gain ranging, and lamps which indicate when level is below 50 mV and above 50 V rms.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 50 V rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 50 V rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3002 Single Range Plug-in	2 Hz to 700 kHz	10 mV to 3 V rms[1]; can be extended to 3 kV rms with Textronix probes. Other ranges available on request.	1 megohm shunted with 40 pF	±0.05°, 50 mV to 500 mV rms from 50 Hz to 50 kHz; typically ±0.03°, 50 mV to 500 mV rms from 50 Hz to 50 kHz, ±0.05° to 10 Hz, ±0.1° to 250 kHz, and ±0.25° at other levels to 500 kHz.
305-PA-3005 High Frequency Plug-in	200 kHz to 11 MHz	1 mV to 3 V rms; manual level controls in 10 dB steps. Lamps indicate when inputs are out of range or when level controls are improperly set.	50 ohms	Broadband with equal inputs above 10 mV rms: ±0.4° from 200 kHz to 4 MHz; ±1° from 4 MHz to 11 MHz. With independent levels above 10 mV rms: ±1° up to 4 MHz and ±2° up to 11 MHz. Single frequency — above 10 mV rms: ±0.3° at any frequency from 200 kHz to 11 MHz at any fixed levels.
305-PA-3007 Programmable and Auto-Ranging Plug-in	2 Hz to 700 kHz	Auto-ranging: similar to levels of 305-PA-3001. Programmable: over-rides autoranging; extends low levels to 1 mV rms; DTL, TTL logic; program connector in rear of mainframe.	1 megohm shunted with 40 pF	Same as 305-PA-3001 for levels above 10 mV rms; typically ±0.35° from 50 Hz to 50 kHz for levels below 10 mV rms.
305-PA-3008 Power Freq. Plug-in	50-500 Hz without filters. 50 Hz, 60 Hz and 400 Hz L.P. filters available[3]	25 V to 250 V rms; 0.1 A to 5 A rms. Inputs are transformer isolated.	100 k ohm (voltage) 1 Ω max. (current)	At any single frequency, with filter set: ±0.1°, 25 V to 250 V rms, or 0.1 A to 5 A rms.
305-PA-3009 Network Analyzer (Gain/Phase/ Amplitude)	5 Hz to 700 kHz (Note: 305-PA-3009A operates to 1 Hz with 305 mod. 14.	10 mV to 40 V rms. Each channel has automatic gain ranging. Direct reading of phase angle, amplitude ratio and level of each input. Compatible with Tektronix probes.	1 megohm shunted with 40 pF	Phase: ±0.1° from 40 mV to 40 V rms from 50 Hz to 50 kHz; typically ±0.25° at all other levels from 5 Hz to 500 kHz. Voltage Amplitude: above 40 mV (channel A or B): ±2% reading ±0.03% FS, 50 Hz to 50 kHz; ±5% reading ±0.03% FS, 100 kHz to 500 kHz.[5] Ratio: ±0.5 dB, 50 Hz to 50 kHz; ±1 dB, 50 kHz to 500 kHz.[5]
305-PA-3010 Special Purpose Plug-in (with filter)	For use at 125 ±10 Hz; matched filters in both channels reject higher frequencies	500 mV to 5 V rms. Other ranges available on request.	1 megohm shunted with 40 pF	±0.1°, 500 mV to 5V rms; ±0.25°, 100 mV to 500 mV rms.
305-PA-3015 Selectable Filter Plug-in	5 Hz to 500 kHz without filters; uses 2 of type 305-PA-3008-( ) filters [3]; filter selection programmable	Ranges of 50-500 mV rms, 0.5 to 5 V rms, and 5-50 V rms selectable by remote contact closures.	1 megohm shunted with 40 pF	With filters, ±0.1° at fixed frequencies over all levels; without filters ±0.1° from 50 Hz to 50 kHz at all levels (typically ±0.03°), typically ±.25°, 5 Hz to 500 kHz.

[1] Can be provided for other voltage levels

[2] For sinusoidal signal; can be used for square wave inputs over limited frequency range; can be used for amplitude modulated signals up to 97% modulation, depending upon model, level and frequency.

[3] 50 Hz filter, P/N 305-PA-3008-50; 60 Hz filter, P/N 305-PA-3008-60; 400 Hz filter, P/N 305-PA-3008-400. (Other frequencies available on request

[4] Available for use with 305-PA-3001, -3002, -3007 and -3010. Specify when ordering plug-in.

[5] For higher accuracy below 50 Hz, specify Model 305-PA-3009A.

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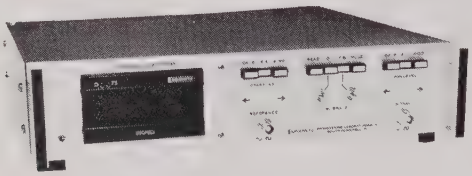
SERIES 331

HIGH ACCURACY ECONOMY PHASEMETERS



- Accuracy to 0.05°, resolution to 0.01°
- Frequency range 2 Hz to 700 kHz
- Analog output and 4 or 5 digit panel readouts
- Input 0.05 to 220 V rms
- Accepts sine, square and other waveforms in either channel

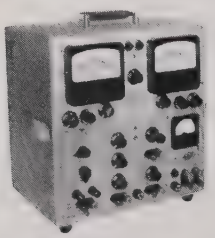
The Dranetz 331 Series Phasemeters feature high accuracy over a broad amplitude and frequency range. Front panel controls (equipped with LO/HI indicators) are used to select proper voltage ranges, as well as to check and adjust calibration. The 331 incorporates several of the important features of the Superperformance 305 Series, including elimination of 0°/360° ambiguity and reduction of sensitivity to noise and even harmonics. The 331 is designed for calibrating equipment, for testing subassemblies and for general laboratory work.

SPECIFICATIONS

CHARACTERISTICS	331B	331C
Frequency Range:	2 Hz to 500 kHz	
Accuracy: Sine Wave:	±0.1° ±1 digit from 50 Hz to 50 kHz, ±0.2° per 100 kHz to 500 kHz and ±0.2° ±1 digit at 5 Hz.	±0.05° from 50 Hz to 50 kHz; ±0.2° from 10 Hz to 100 kHz; add ±0.2° per 100 kHz above 100 kHz.
Square Wave:	±0.1° ±1 digit from 10 Hz to 20 kHz; ±.5° per 100 kHz above 20 kHz	±0.05° from 10 Hz to 5 kHz; ±0.1° to 20 kHz; ±0.5° per 100 kHz above 20 kHz.
Angle Ranges:	000.0° to 360.0° or −180.0° to +180.0° automatic or selectable.	
Display:	Beckman (Sperry) 0.6″ 4 digit for ranges above.	Beckman (Sperry) 0.6″ 5 digit for ranges above.
Drift (30 day period): Sine Wave: Square Wave: DC Drift:	None None 0.1°	
Repeatability (DC):	Better than 0.1°.	Better than 0.01° after readjusting 0 and FS.
Temperature Coefficient:	0.01°/°C independent of other conditions.	
Input Signal Amplitudes:	0.05 to 220 Volts rms in 3 ranges (0.05-0.5, 0.4-5, 4-220; can be extended with Tektronix probes.	
Input Impedance:	1 megohm shunted by 50 pF nominal	
Response Time:	700 milliseconds	
Maximum DC Component:	±200 volts; can be extended with probes	
Analog Output:	0.0000 to 3.600 V and −1.8000 to +1.8000 V DC, +10.00 mV DC/degree phase; output impedance less than 100 ohms.	
Ambient Temperature	0°C to 45°C	
Panel Controls and Adjustments:	3 range input level pushbuttons each channel; read-hold; power; 0° cal and 360° cal adjustments.	
Connectors:	BNC, both input channels, rear and front; PC rear for analog output.	
Power Requirements:	105-125 or 210-250 volts, 50/60 Hz, 70 watts.	
Dimensions:	3½″ high x 16″ deep, 19″ rack/portable package, 18 lbs. (7 kg) net wt., 25 lbs. (10 kg) shipping.	
Option:	#101: BCD output, TTL/DTL, 8421	#101: BCD output, TTL/DTL, 8421

SERIES 100 NETWORK ANALYZER

COMPLEX IMPEDANCE, ADMITTANCE AND TRANSFER FUNCTION METERS



APPLICATIONS

- Production Testing
  Capacitors, inductors, transformers
- Linear Network Design
  Filters, amplifiers, linear IC's
- Acoustic and Electromechanical Analysis
  Transducers, arrays, interacting fields
- Linear and Non-linear Device Design
  Piezoelectric, dielectric, magnetic devices

MEASURE... RECORD... PLOT...

$$Z = R + jX = |Z| \angle\theta z \qquad Y = G + jB = |Y| \angle\theta y$$

$$\frac{V_0}{V_1} = \left|\frac{V_0}{V_1}\right| \cos\theta + j \left|\frac{V_0}{V_1}\right| \sin\theta = \left|\frac{V_0}{V_1}\right| \angle\theta$$

These instruments provide rapid measurements of impedance, admittance and transfer function parameters. Panel meters give direct reading, and DC outputs are used for frequency plots. Consisting of 100C main frame and choice of plug-in, the instrument is exceptionally flexible. Plug-in 100-PA-1001A is used for both impedance and admittance* measurements. 100-PA-1008 is for differential admittance measurements, to improve accuracy of minor components.

PLUG-INS

Model 100-PA-	Measures	Frequency Range	Linear Ranges, Full Scale 1, 2.5, 5, etc. Sequence	Voltage Across or Current Through Unknown (RMS)
1001A	Z & Y	100 Hz to 200 kHz	10 Ω to 50 kΩ 10 μ℧ to 50 k℧	0-45 mV in Z mode; 3 V in Y mode
1008	Y or △ Y*	100 Hz to 100 kHz	100 μ℧ to 500 m℧	3 V

For further details on Series 100 write for bulletin 100, Tech. 1, and Tech. 3. Patents #3,267,355 and #3,275,933.

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SERIES 325

POWER SYSTEM POLYMETER / DUAL MEASURE OF VOLTAGE, CURRENT, TIME, FREQUENCY

FEATURES

- Simultaneous measurement and display of two selectable parameters.
- Display of continuous, triggered or maximum readings.
- Full isolation of all inputs.
- Precision measurement of time interval in seconds or cycles.
- Large 0.6″ digital display.
- Precision frequency measurement optional.
- Portable for field use.
- A field instrument with laboratory accuracy.

The Series 325 is specifically designed for measuring key parameters in electric power systems. Simultaneous measurements of Voltage and Current, 2 Currents, 2 Voltages, Current and Time, and Voltage and Time may be made. Readings may be taken on a continuous basis, or the meter may be triggered to "freeze" readings at a specific time. Time may be measured either in seconds or cycles of the power line frequency. Timing and trigger inputs may be actuated from type A or B dry contacts or by AC or DC voltages. Special circuits assure positive triggering on first contact and prevent simultaneous start/stop conditions. Options and adapters are available for DC current, DC voltage, fast frequency measurement, low pass filters and BCD outputs.

APPLICATIONS

- Ideal for electric utility use.
- Testing of trip points on overcurrent, overvoltage, undercurrent, undervoltage, and underfrequency relays.
- With Model 314 Phase Angle Meter, ideal for impedance relays.
- Precision measurement of frequency.

SPECIFICATIONS

Frequency Range: 47-450 Hz. (25 Hz available on request.)
AC Voltage: 15 mV to 1000 V RMS, 1.5, 15, 150, 1000 V FS, transformer isolated, 5000 ohms per volt.
AC Current: 1.5 mA to 100 A RMS, 0.15, 1.5, 15, 100 A FS, transformer isolated, .001 ohms insertion resistance.
Time Interval (2 ranges): 0 to 999.99 seconds in .001 second increments. 0 to 9999.9 cycles in 0.1 cycle increments.
Trigger Inputs: (Start and Stop) Contact closure, DC step voltage change, or AC input.
Accuracies: V, I, ±0.3% reading ±0.03% FS; Time, ±0.003% reading ± last digit.
Out of Range: Display blinks when level is too high.
Measurement Modes: Continuous, triggered, and "hold maximum."
Dielectric Test: 4250 V RMS to ground from V and I terminals. 1600 V RMS to ground from trigger terminals. (Per ANSI-C39.5.) Also meets SWC test.
Power Supply: 95 to 140 or 190 to 280 V RMS, 47 to 450 Hz, 20 watts, International Universal type connector.
Operating Temp. Range: 0°F. to 125°F.
Case: Portable, weatherproof, with cover 11″L x 7″W x 9½″D (28cm L x 18cm W x 24cm D); without cover 11″L x 7″W x 7″D (Panel 11″ x 7″).
Weight: 10 pounds. (Shipping weight, approximately 17 pounds.)

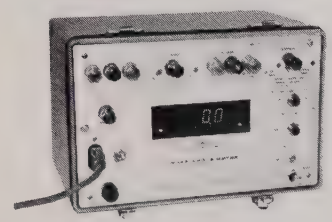
OPTIONAL FEATURES

Option 101: Fast frequency measurement capability — 0.1 sec. meas. time, 0.01 Hz resolution; 1 sec., .001 Hz resolution; accuracy ±0.002 Hz ± resolution.
Option 102: Low pass filters for removing effects of harmonics from measurements.
Option 103: BCD outputs suitable for driving printers for recording measured data. DTL/TTL compatible.
Option 105: True RMS detection.
Option 106: Panel mount.
Option 107: Panel mount with remote display.
Option 108: Accessory power for 325-PA-( ) adapters.
Option 109: Dry contacts corresponding to START/STOP times (available only when Option 108 is chosen.)
325-PA-1001: DC Current Adapter.
325-PA-1002: DC Voltage Adapter.
325-PA-1003: Contact Opening Trigger Adapter.
325-PA-1004: Adjustable Threshold Trigger Adapter.

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 325 A

SERIES 314

POWER SYSTEM PHASEMETER / FOR ACCURATE & RAPID MEASUREMENT OF PHASE IN ELECTRIC POWER SYSTEMS



FEATURES

- Universal Current-Voltage Inputs, V-V, I-I, V-I
- Portable
- Immune to Harmonics
- Independent of Frequency Changes
- Digital Readout — "No Hands" Simplicity
- Accuracy ±0.5°, Resolution ±0.1°
- Independent of Input Levels
- Complete input isolation

APPLICATIONS

- Testing and Adjustment of Protective Relays
- Measuring Load Current Phase Angles — Measuring Power Factor
- Testing Polyphase Balance
- Determining Power Flow in Interconnected Systems
- Minimizing Circulating Reactive Currents
- Synchronizing Multiple Sources

Accurate, precise and rapid phase measurement is an essential technique in the setup, operation, and maintenance of modern power systems, subsystems, and the control and protection circuits used in them. The value of a phase meter in such applications is directly proportional to the speed, convenience, and validity with which it indicates the phase angles it measures. With the introduction of the Dranetz Model 314, virtually all of the limitations and error sources of electromechanical meters have been removed, and the overall accuracy of this class of phase measurements has been increased by more than a full order of magnitude. The basic accuracy of ±0.5° specified for the Model 314 is actually **maintained, without degradation,** over the wide ranges of frequency variation, voltage/current level, and harmonic content for which the instrument is rated. Furthermore, the direct-reading **digital** presentation of phase, to four-place resolution (0.1° increments) requires no interpretation or interpolation, and is not subject to reading errors or parallax. **The phase angle you see is the phase angle that exists — to within ±0.5°,** without correction or uncertainty.

SPECIFICATIONS

ELECTRICAL

Range: 000.0° to 360.0°, Direct-reading
Frequency Range: 47-53, 57-63 Hz (specify at time of ordering)
Input Current Range: (both input circuits) .015-50 A rms
Input Voltage Range: (both input circuits) 0.3 to 600 V rms
Current-Input Impedance: Approx. 2 or 20 milliohms
Display: Four digits, non-flickering, 0.6″ numerals
Resolution: 0.1°
Accuracy: ±0.5°
Burden:
Voltage: 1.8 VA max. at 600 V rms input
Current: Approx. 2.5 VA at 50 A rms input
Interaction Between Inputs: None
Errors Due to Harmonic Distortion: None for harmonic distortion up to 30%, any harmonic
Errors Due to Offground Inputs or Reversal: None
Overload:
Voltage: 100% overload for 1 minute
Current: 100 A rms for 1 minute
Dielectric Test: Up to 2200 Volts rms between inputs and ground (ANSI-C39.5)
Self-Check: Provided for 000.0°. Full scale (360.0°) is autocalibrated internally
Power Required: 115/230 V, 50-60 Hz, 20 Watts

MECHANICAL AND ENVIRONMENTAL

Case: Portable weatherproof carrying case with cover 11″L x 7″W x 9½″D (28cm L x 18cm W x 24cm D). Without cover 11″L x 7″W x 7″D. (Panel 11″ x 7″)
Operating Temperature Range: 10°F to 110°F
Weight: 10 pounds approx. (shipping wt. approx. 17 pounds)

FOR FULL INFORMATION AND DETAILED SPECIFICATIONS WRITE FOR BULLETIN 314A

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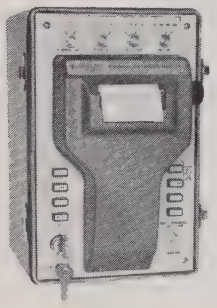
SERIES 606

POWER LINE DISTURBANCE ANALYZER/RECORDER



- For 115/230/460 V rms, 1 and 3 phase systems.
- Monitors, classifies, times and prints out line disturbances.
- Immediate and day-end printouts.
- Operates on command or disturbance — no wasted paper.
- For portable or permanent installation.
- 4 hour internal carry over power.

The 606 is designed specifically for monitoring power mains connected to computers, process control systems, hospital equipment and data communications devices, which are particularly susceptible to line transients, level changes or other disturbances. Using a digital microprocessor, the 606 classifies each disturbance into IMPULSE, CYCLE-TO-CYCLE CHANGE or SLOW RMS CHANGE. When preset thresholds are exceeded, the instrument prints out time, classification, magnitude, duration and channel designation. Data is also accumulated for overflow and day-end printout. The instrument is designed for unattended monitoring in a permanent installation or for temporary use at more than one site.

SPECIFICATIONS

Input Voltage Ranges: 115, 230, 460 V rms ±50%, all transformer isolated, Zin > 100 kΩ

Number of Inputs: Model 606-1, 1 input; Model 606-3, 3 inputs (3φ or separate circuits)

Test Modes:

AVG+ or AVG−: Increase or decrease in steady state rms, averaged over 10 sec

SURGE or SAG: Increase or decrease in cycle-to-cycle rms value

IMPULSE: 0-peak value of impulse (excluding line voltage waveform) having duration 0.5-100 μsec

ACCUMULATED COUNT: Summation of disturbance data in memory (includes time, HI AVG+, LO AVG−, HI SURGE and number of HITS, LO SAG and number of HITS, HI IMPULSE and number of HITS)

Printing Modes:

AVG+ or AVG−: Prints time, AVG+ or AVG−, rms VALUE, CHAN., when exceeding threshold of 2, 5, 10, 15 V rms*

SURGE or SAG: Prints time, SURGE or SAG, rms VALUE, CHAN. and duration (cycles) when exceeding threshold of 2, 5, 10, 20 V rms*

IMPULSE: Prints time, IMPULSE, 0-pk VALUE (excluding line voltage) and CHAN, when exceeding 0-pk threshold of 50, 100, 200, 400 V

SUPPLY DOWN or UP: Prints POWER OFF or POWER ON and TIME

STORED DISTURBANCES: Stores data on disturbances during printing. Prints out when printer clears

ACCUMULATED COUNT: (Short Term) Overflow of data entering printer. Prints out automatically

DAILY ACCUMULATED COUNT: End-of-day print out. Prints number of day and ACCUMULATED COUNT

TEST: Prints time and ACCUMULATED COUNT

RESET: Prints time and ACCUMULATED COUNT, resets memory

PRINT OFF: Prints PRINT OFF and TIME, disables printer, all data goes into accumulator for delayed summary printout

Accuracy:

AVG+ or AVG−: At 60 Hz (sine wave signal), ±1% of reading ±1% of nominal input

SURGE or SAG: At 60 Hz (sine wave signal), ±1% of reading ±1% of nominal input

IMPULSE: ±5% of reading ±1% of maximum impulse calibrated with a positive going, 10 μsec, half sinewave impulse. 6 dB bandwidth with half sinewave impulses: 100 μsec to 0.5 μsec

Clock: Indicates real time in hours, minutes, seconds, crystal controlled. During power off, operates on internal batteries (4 hours). Clock resets from front panel buttons

Printer: 17 character, alpha-numeric, thermal, paper 2¼″ wide, prints 1 line/sec

Supply Power: 90 to 140 V, 45-450 Hz, 1φ, 1.0 A maximum

Case: Portable, aluminum, weatherproof, removable cover, equipped with carrying handle and feet

Size (with cover): 11″H x 7″W x 9½″D; net weight, 16 lbs.

Options: Opt. 101 (606-3 only), freq. disturbances; Opt. 102, supply power 230 V nominal, 45-65 Hz; Opt. 103 (606-3 with Opt. 101 only), monitors 400 Hz power lines

*These values for 115 V input; multiply by X2 or X4 for 230 V rms or 460 V rms.

MODEL K103 TEST KIT: Includes calibrated disturbance generator designed to verify operation of Series 606. Also includes a set of programmed memories containing checkout routines. Card puller and extender board are also included.

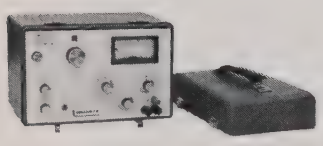
MODEL 910 UNINTERRUPTIBLE POWER SUPPLY: For line interruptions up to 4 hours, 606 itself prints power down and return times, maintains clock operation and retains accumulated data in memory. For complete operation of 606 during power shutdown up to 2 hours, use Dranetz Model 910 uninterruptible power supply.

CHARACTERISTICS: Nominal input 95-140 V rms, 47-450 Hz; size, 11″ x 7″ x 9½″.

FOR FULL INFORMATION WRITE FOR BULLETIN 606A

SERIES 602

FREQUENCY SELECTIVE VOLTMETER



- Broad range — 2 kHz to 350 kHz.
- High selectivity — spurious signals down more than 50 dB.
- Battery powered — long life.
- Excellent for K and N carrier systems.
- Meets W.E. KS-15538-L5A

The Dranetz Model 602 Frequency Selective Voltmeter is a low power transistorized instrument for the measurement of carrier signals hidden among other multiple signals. The instrument uses a frequency selective detector based on heterodyning to cover a broad frequency range, and uses a crystal oscillator for frequency and level calibration. The instrument has both high impedance and bridging inputs for 135 or 600 ohms (balanced or unbalanced).

SPECIFICATIONS

Frequency Range: 2-350 kHz

Input Levels:

Full Scale Ranges: −60 to +20 dBm, 5 dB/step

Sensitivity: −70 to +22 dBm

Selectivity: Spurious output down more than 50 dB

Accuracy:

Level: 135 ohm input, ±.25 dB
600 ohm input, ±.5 dB

Calibrator: ±.25 dB at 35 kHz ±250 Hz

Frequency: ±1 kHz or ±500 Hz

Frequency Response: ±1 dB ref 25 kHz

Meter Bandwidth: Nominal 500 Hz at −3 dB, 1000 Hz at −60 dB

Audio Bandwidth: Nominal 2.5 kHz at −6 dB, 8 kHz at −60 dB

Internal Noise: At least 20 dB below full scale

Battery Drain: 80 mA nominal

Size: 11″L x 7″W x 9½″D (28cm L x 18cm W x 24cm D) with cover; panel 7″ x 11″

Weight: Net 10 lbs., shipping 15 lbs.

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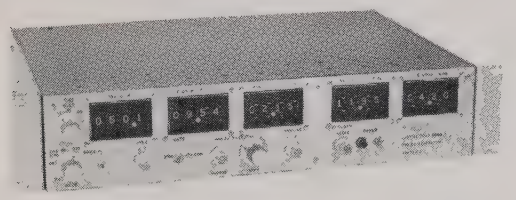
SERIES 206A

DIGITAL GATING/TIMING GENERATOR



Series 206A GATING/TIMING GENERATORS gate the output of an a-c signal generator and provides a single signal burst or repetitive signal bursts, with turn-on and turn-off times coincident with zero crossings of the input signal to minimize switching transients.

Internal or external triggering initiates an accurate sequence of pulses for: (1) turning on the signal at its first positive going zero crossing; (2) turning off the signal at the first positive going zero crossing following a precise time interval; (3) delayed triggering of oscilloscopes or other devices; (4) gating detectors or receivers after a precise time interval; (5) delayed triggering of Dranetz Series 215 AC Sampling Voltmeters or Series 202 CW/Pulse Vector Component Computer systems.

APPLICATIONS:

- Automatic a-c testing of components and circuits.
- Testing of data communications systems, modems, multiplexers and switching circuits.
- Calibration of underwater transducers under tone burst conditions.
- Measurement of propagation and reflections in acoustical fields.

FEATURES:

Wide frequency range of 50 Hz to 3 MHz.

Provides zero-crossing turn-on and turn-off of a-c signals, single or repetitive gating.

Provides three additional independently selectable timing pulses for controlling gated detectors and receivers.

Digitally-controlled timing from front panel controls.

Remote programming.

SPECIFICATIONS

MODES OF OPERATION:
CW
Gated: (for CW, FM or Phase-shifted signals).
Single shot or repetitive gating of AC signals.
Repetitive gating using internal timing oscillator (with or without sync. to 60 Hz power line).

SIGNAL CHANNEL:
Frequency range: 50 Hz to 3 MHz.
Input: — Sinusoidal signal, 1 V rms ±10%.
Impedance—10 kΩ shunted by 100 pF.
Output: Level — Adjustable from 0.1 to 1 V rms into 75Ω load over full frequency range; adjustable from 0.5 to 5 V rms into 10kΩ up to 2 MHz.
Distortion — Less than ½% from 50 Hz to 0.5 MHz; <1% to 3 MHz.
Input to output isolation: >60 dB to 0.5 MHz; noise typically 60 dB down.
Types of gating: Zero crossing turn on and zero crossing turn off; less than 1.5° or 25 nsec coincidence error. Non-synchronous turn-on and turn-off.

EXTERNAL TRIGGER:
Pulse or square wave input, ±5 V into 3 kΩ load, transformer input, rise time 50 μsec max, duration 50 μsec. min.

GROUNDING:
Separate chassis, circuit and power line grounds.

CONNECTIONS:
Connections on rear; monitor outputs on front.

CONTROLLED TIMING:
Repetition Period: 100 μsec to 99.99 sec.
Signal On-Time: 10 μsec to 9.999 sec.
Transient Delay Pulse: 10 μsec to 9.999 sec.
Receiver Delay: 10 μsec to 9.999 sec.
Receiver On-Time: 10 μsec to 9.999 sec. (Note: Timing operates with or without AC signal input.)

OUTPUT CONTROL PULSES:
Sync. Output: +5 V pulse at signal turn-on followed by −5 V pulse at delayed receiver turn-on.
Signal gate output (for use with commercial E-I Normalizers): +10 V rectangular wave, having leading edge coincident with signal turn-on and lagging edge coincident with signal turn-off.
Signal transient delay output: +10 V rectangular wave having lagging edge coincident with setting of Transient Delay Control.
Receiver enable output: +10 V rectangular wave having leading edge corresponding to Receiver Delay Control, and pulse width corresponding to Receiver On-Time Control.

EXTERNAL PROGRAMMABLE FEATURE:
Parallel BCD rear panel inputs for each timing control. Remote operation on zero position of manual controls. Switch closure to ground or application of 0 to +0.8 V dc is binary one; open circuit or application of +2 to +5 V dc is binary zero. For switch closure, Model 206A produces 3.2 mA dc max. For manual setting of controls, rear connectors produce BCD outputs corresponding to control positions.

INPUT POWER:
105 - 125 V 50 - 60 Hz, 40 watts.
SIZE: 3½" high x 17" wide x 15½" deep (with hardward for mounting in standard 19" relay rack).
WEIGHT: 20 pounds; shipping, 30 pounds.

DRANETZ
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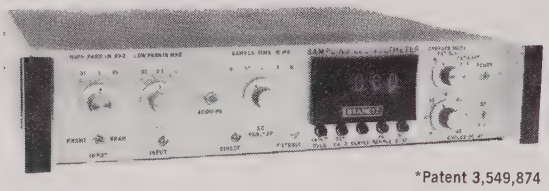
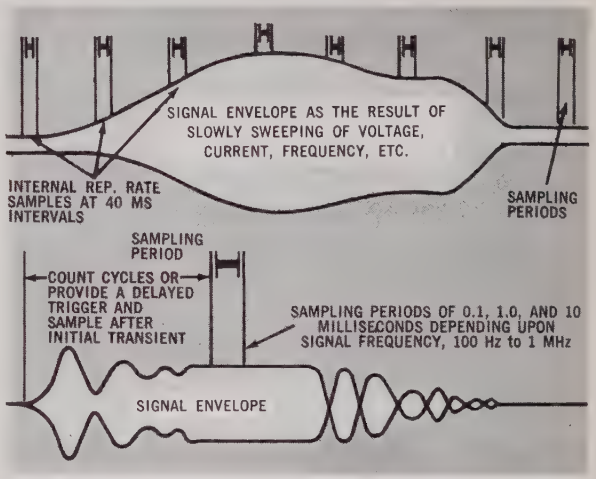
SERIES 220A

HIGH SPEED LOG SAMPLING VOLTMETER *

Direct digital readout of CW, Gated AC, or rapidly varying AC signals



*Patent 3,549,874


SIGNAL ENVELOPE AS THE RESULT OF SLOWLY SWEEPING OF VOLTAGE, CURRENT, FREQUENCY, ETC.
INTERNAL REP. RATE SAMPLES AT 40 MS INTERVALS
SAMPLING PERIODS
SAMPLING PERIOD
COUNT CYCLES OR PROVIDE A DELAYED TRIGGER AND SAMPLE AFTER INITIAL TRANSIENT
SAMPLING PERIODS OF 0.1, 1.0, AND 10 MILLISECONDS DEPENDING UPON SIGNAL FREQUENCY, 100 Hz to 1 MHz
SIGNAL ENVELOPE

FEATURES:

- Frequency range - 100 Hz to 1 MHz
- Sample and hold output - analog and digital outputs
- Single or repetitive measurement to 1000 samples per second
- Sampling times down to 100 μsec
- Output independent of sampling time or duty cycle
- 84 dB dynamic range - 300 μV to 5 V (to 5 kV with voltage probes)
- Logarithmic digital display and BCD outputs
- Complete programmability for either remotely controlled or computer controlled test systems
- Rejects unwanted signals up to 50 dB higher than desired signal

APPLICATIONS:

- High speed component testing
- Analysis of time-varying or transient effects
- Measurement of direct or reflected acoustical signals
- Measurement of signal burst levels applied to radiators or receivers.

The Model 220A Sampling Voltmeter is a gated, average responding voltmeter for measuring amplitude of AC signals during a short sampling time. Measurement can be made of rapidly varying CW signals, gated AC signals (tone bursts), or single shot AC signals. Measurements are made at any predetermined time in a selected period which can be as short as 1 cycle of the signal.

Sample and hold output circuitry, combined with internal logarithmic conversion, provide several simultaneous outputs: a digital panel meter reading directly in DBV (ref: 0 DBV = 1 V rms), a linear DC output, two logarithmic DC outputs, and a logarithmic digital output (BCD code) corresponding to the digital panel meter reading. Provision is made for insertion of an external DC signal which allows both the digital display and BCD output to correspond to other logarithmic parameters without effecting instrument calibration.

This instrument combines internal low and high pass filtering, a unique average responding detector, and logarithmic conversion to offer an exceptionally wide dynamic range, high sensitivity, wide frequency range, short sampling time and low susceptibility to noise and signal distortion compared to peak responding and rms AC instruments.

SPECIFICATIONS Model 220A

Signal Frequency Range: 100 Hz to 1 MHz.

Accuracy: ±0.3 dB to 200 kHz, ±0.5 dB 200 kHz to 1 MHz.

Resolution: Analog output - infinite Digital readout and output: 0.1 dB.

Dynamic Input Range: −70 to +14 dBV (ref. 0 dBV = 1.0 V rms) (0.3 mV to 5 V rms).

Input Circuit Configuration: Single ended, front and rear panel input jacks (BNC)

Signal Input Impedance: 1 megohm

Output Indication: (1) Digital panel meter: −70 to +14 dBV, ±199.9 dB max. indication with external DC scaling input (2) DC analog outputs, Zo = 600Ω, drives 10kΩ min. load resistance:

A. Log, 0.05 V/dB, +0.0 to +4.2 V out.

B. Log, 1 mV/dB −70.0 mV to +14.0 mV (0 V dc out ref 1 Vrms in).

C. Linear, +0.5 to +5 V dc.

(3) BCD outputs, 12 lines (8-4-2-1 BCD) TTL, DTL compatible logic

Offset Scaling: Adjustable DC offset of digital display and log output (1 mV/dB); front panel control for continuous 0 to ±100 dB offset.

Repetition Rate: Internal trigger generator approx. 10 samples/second. External trigger: 1 to 4 ms required between samples for analog DC outputs depending upon sample time; 10 msec min repetition rate for digital display and BCD outputs.

Sampling Period: Periods approx. 0.1, 0.3, 1, 3 and 10 msec. Requires min of 1 full cycle.

Filters: 0.1, 1 and 10 kHz high pass; 0.01, 0.1 and 1 MHz low pass.

Sample and Hold Facility: Output transfers from level to level without discharge. DC outputs drift less than 0.2 dB per minute after last sample. Digital output can be programmed for infinite hold.

Trigger Input (to initiate sampling): Square wave, pulse, or step, ±5 V peak, rise time < 50 μsec (10-90%) transformer input, ungrounded, input impedance approx. 5k ohms.

Delay Control to Mask Signal Transients: Below 0.5 MHz, selectable cycle count 4 to 300 cycles; above 0.5 MHz, selectable time delay of 8 to 600 μsec.

Monitor and Control Outputs: (1) Synchronizing pulses for external equipment. (2) AC monitor outputs: Filtered and unfiltered signal level approx. 2V pk-pk; filtered output has 0.5 volt pedestal indicating sampling time. (3) Fault indicating signals available at rear panel.

Visual Indicators: For overloads, correct sampling, sampling period, low and high pass filter selection, incorrect sampling and loss of signal input.

Compatibility: Compatible with Dranetz Gating/Timing Generator 206, and other pulse generators.

Programmability (rear connectors): Compatible with DTL and TTL; also operable by remote contact closures. Filter selection, sample period, timing and other functions are programmable.

AC Input Power: 115/230 V, 50-60 Hz, 35 watts

Size: 3½" high x 17" deep x 17" wide equipped for 19" rack mounting.

Weight: 25 lbs.; Shipping, 35 lbs.

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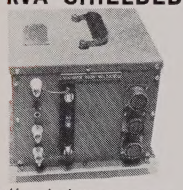
TR-SERIES SPECIAL PURPOSE INSTRUMENT TRANSFORMERS

TR-2001 3 kVA SHIELDED ISOLATION TRANSFORMER



FEATURES
- Excellent isolation between source, load and bridge
- Electrostatic shielding
- Low capacitance, low leakage inductance
- High power — 3 kVA
- Broad frequency range

APPLICATIONS
- High power bridge measurements
- Decoupling power amplifiers
- Driving reactive loads

Construction: Single shielded primary and three shielded secondary windings. Winding A has very low capacitance to shield. Winding B has moderate capacitance to shield and moderate leakage inductance. Winding C has very low leakage inductance. All shields connected to frame.

Frequency Range: $<$ 60 Hz to $>$ 25 kHz.

Maximum Power (primary): 1) Max. I: 3 Amps (rms). 2) Max. V: At 60 Hz, 130 V (rms). Increases in proportion to freq.; 1000 V (rms), 460 Hz to 25 kHz.

Impedance Loads: 5 Ω to 10 kΩ.

Winding Characteristics: 1) Primary: R $<$ 0.5 Ω, C approx. 4500 pF. 2) Secondary A (turns ratio 1:1): R $<$ 1 Ω, Cs $\approx$ 300 pF, $L_L \approx$ 0.3 mH (X_{LA} approx. 35 Ω at 20 kHz). 3) Secondary B (turns ratio 1:1): R $<$ 0.7 Ω, C $\approx$ 1500 pF, $L_L \approx$ 0.1 mH (X_{LB} approx. 13 Ω at 20 kHz). 4) Secondary C (turns ratio 2:1) R $<$ 0.3 Ω, C $\approx$ 2000 pF, $L_L \approx$ 0.06 mH (X_{LC} approx. 8 Ω at 20 kHz).

Fuse: Primary winding fused with HV fuse.

TYPICAL LOW LEVEL FREQ. RESPONSES

Secondary Winding	Load Resistance (ohms)	Freq. Range for Response Variation Less than ±0.1dB	Upper Half Power Freq. (3dB down)
A	1000	20 Hz to 50 kHz	500 kHz
C	5	20 Hz to 600 Hz	10 kHz
C	30	20 Hz to 5 kHz	70 kHz
C	100	20 Hz to 20 kHz	100 kHz

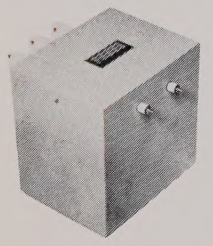
Electrical Ground: Case, frame and shields connected together.

Size: Approx. 10½″ x 11″ x 9½″ high (excluding protective fuse and carrying handle).

Connectors: Primary: Ceramic feed-throughs, 10 x 32 studs. Secondary: Female receptacle for each secondary winding, type MS 3102A-22-8S, mating MS 3106A-22-8P supplied.

Wt.: 55 lbs. approx. **Ship. Wt.:** 75 lbs. max.

TR-2003 10 kVA STEPDOWN ISOLATION TRANSFORMERS



FEATURES
- Single ended and balanced inputs
- Excellent amplitude and phase fidelity over wide frequency range
- High input impedance — low output impedance

APPLICATIONS
- Measurement of amplitude and phase of high voltage sources
- Impedance, phase and power measurements on high power electroacoustical transducers
- Testing of high voltage components such as inductors and transformers

SPECIFICATIONS
Turns Ratio: 1000: 1 ±1% at 1 kHz.

Frequency Response: Amplitude: Push-pull: ±1%, 20 Hz to 30 kHz; Single-ended: ±1%, 20 Hz to 9 kHz. Phase: Push-pull: ±2°, 20 Hz to 30 kHz; Single-ended: ±2°, 20 Hz to 9 kHz.

Primary Center Tap: Within 0.5% of true center.

Max. Input Voltage: Push-pull, CT grounded: 10 kV rms, 100 Hz to 30 kHz; Single-ended: 10 kV rms, 100 Hz to 9 kHz; Peak voltage: 15 kV, either terminal to case.

Input Impedance (Vector): Above 100 Hz, approx. 2 meg. Ω; below 100 Hz, progressively decreasing with lower freq. (approx. 1 meg. Ω at 60 Hz).

Insulation to Case: Primary: 1000 megohms; Secondary: 1000 megohms.

Internal Power Absorption: Increases as square of voltage, to less than 10 W at full voltage limit.

Load Impedance: Characteristics stated herein apply for resistive loads between 1 k ohm and 10 k ohm.

Size: Approx. 6¾″ x 5¼″ x 7″ high excluding terminals and mounting studs.

Terminals: 3 Ceramic primary, 2 ceramic sec.

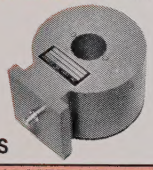
Breakdown to Case: Primary: 18 kV rms; Secondary: 1 kV rms.

Bias Current: DC bias current should not be placed through windings.

Construction: Steel encased, oil filled, mounting studs 5⅝″ x 3¼″ centers (studs ¼″ x 20″ x ⅝″ long).

Wt.: Approx. 26 lbs. **Ship. Wt.:** Approx. 32 lbs.

TR-2004 — TR-2005 CURRENT TRANSFORMERS



FEATURES
- Output voltage is faithful reproduction of input current
- Wide frequency and dynamic range
- Excellent pulse and phase response
- High voltage isolation
- 1¼″ D hole for primary

APPLICATIONS
- Testing sonar projectors and arrays
- High power immitance and transfer measurements
- Measuring transients in SCR's
- Measuring electron beam currents
- Current sensing in AC feedback systems

SPECIFICATIONS

CHARACTERISTIC	TR 2004	TR 2005
Sensitivity per Primary Turn (V rms/A rms)	0.1; +0, −1%	1.0; +0, −1%
Square Pulse Input		
Max. Current	10,000 A pk	1,000 A pk
Rise Time	For rise times $>$ 1 microsec.	40 nanosec. approx.
Droop	10^{-4}%/microsec.	10^{-2}%/microsec.
Max. Amp-sec. per pulse	1	0.1
For Sinusoidal Input		
Amplitude Limit	100 A rms above 17 Hz; 9 A pk/Hz below 17 Hz; 90 A pk at 10 Hz	10 A rms above 100 Hz; 0.15 A pk/Hz below 100 Hz; 7.5 A pk at 50 Hz
Useful Frequency Range	0.25 Hz to 700 kHz	20 Hz to 10 MHz
Amplitude Response with Frequency +0%, −1% Limits	4 Hz to 100 kHz	1 kHz to 4 MHz
Low Frequencies	3 dB at 0.25 Hz	3 dB at 20 Hz; −3% at 200 Hz; −5% at 100 Hz
High Frequencies	3 dB up to 700 kHz; +2.5% at 300 kHz; +7% at 400 kHz	3 dB at 10 MHz
Phase Response ±0.8° Limit	20 Hz to 100 kHz	1 kHz to 2 MHz
Low Frequencies	1.5° at 10 Hz; 2.9° at 5 Hz	2° at 500 Hz; 4° at 250 Hz; 8° at 100 Hz; 13° at 50 Hz
High Frequencies	1.5° at 200 kHz; 2.2° at 300 kHz	2.7° at 5 MHz
Electrostatic Shielding With 1000 volts rms at 5 kHz on primary, secondary output corresponds to less than:	10^{-4} ampere turns through primary	10^{-5} ampere turns through primary
Maximum Insertion Impedance	0.0002 ohms	0.02 ohms
Maximum Voltage	15 kV pk surface to high voltage; 30 kV pk with primary insulation	
Typical Primary Capacitance	6 pF in oil; 3 pF in air	
Recommended Load	$>$ 10,000 Ω in parallel with $<$ 20 pF	
Dimensions	(approx) 5″ OD x 1¼″ ID x 2½″ high plus mounting flange (4 mounting holes on flange: ¾″ D on centers 1¾″ x 2½″)	
Connector	BNC	
Weight	4 pounds approx.	
Shipping Weight	8 pounds approx.	

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